CODEN [USA]: IAJPBB ISSN: 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

http://doi.org/10.5281/zenodo.2546430

Available online at: http://www.iajps.com ***Review Article***

CAUSES AND MANAGEMENT OF OSTEOMYELITIS

Ammar Fareed Qutub[1], Alaa Jamal Akbar[1], Ghassan Abdulhamid Alnajjar[2], Mahdi Hussain Al-Saad[3], Abdulrahman Jubair M Aljubair[4], Shroug Ali Algoba[5], Ali Mohammed Ali Almousa[6]

[1]King Abdulaziz University, [2]Ghassan Abdulhamid Alnajjar, [3]Oyun City Hospital, [4]Al-Imam Mohammad Ibn Saud Islamic University, [5]King Faisal Hospital In Makkahi, [6]Alomran General Hospital

Abstract:

Introduction: *Depending on the infection's particular features (etiology, pathogenesis, extent of bone involvement, and duration) and the patient (infant, child, adult, or immunocompromised) a variety of challenges is present of osteomyelitis in long bones. Tremendous progress was made in the four past decades in the treatment of osteomyelitis as the many factors that account for the occurrence and persistence of infection have been found and a variety of antimicrobials with other spectrums of activity against microbes have been developed.*

Aim of work: *In this review, we will discuss etiology, presentation, diagnosis, and management of osteomyelitis*

Methodology: *We conducted this review using a comprehensive search of MEDLINE, PubMed, and EMBASE, January 1985, through February 2017. The following search terms were used: osteomyelitis, causes of osteomyelitis, diagnosis of osteomyelitis, treatment of osteomyelitis*

Conclusions: *Treatment of long bone osteomyelitis is hard and is a significant cause of morbidity and expense. The aim of treatment is to stop the spread of osteomyelitis and repair the damage it has caused. Proper therapy consists of culture-directed antibiotic therapy and surgical debridement of all bone with necrosis and soft tissue. Antibiotic therapy (including a combination of antibiotics and a variety of delivery systems), debridement (often multiple), dead space management, soft tissue coverage, restoration of blood supply, and stabilization, are the stages of treatment*

Key words: *osteomyelitis, bone infection, infectious diseases.*

Corresponding author:
Ammar Fareed Qutub,
Ammarfq@Gmail.Com,
+966555502378

QR code

Please cite this article in press Ammar Fareed Qutub et al., ***Causes and Management Of Osteomyelitis.,*** *Indo Am. J. P. Sci, 2019; 06(01).*

INTRODUCTION:

Depending on the infection's particular features (etiology, pathogenesis, extent of bone involvement, and duration) and the patient (infant, child, adult, or immunocompromised) a variety of challenges is present of osteomyelitis in long bones. Tremendous progress was made in the four past decades in the treatment of osteomyelitis as the many factors that account for the occurrence and persistence of infection have been found and a variety of antimicrobials with other spectrums of activity against microbes have been developed. Classification of osteomyelitis is based on duration (acute or chronic), pathogenesis (trauma, contiguous spread, hematogenous, surgical), extent, site, or type of patient, despite the fact that different authors described osteomyelitis to several classifications, the two most commonly used in the medical literature and in clinical practice are the classification systems by **Waldvogel et al. [1] and Cierny et al. [2]**. The first description of osteomyelitis was according to duration, either acute or chronic, under the Waldvogel system. Second, classification of disease is according to the source of infection, as contiguous focus when it originates from infection in a nearby tissue or as hematogenous when it originates from a bacteremia. Vascular insufficiency is the final category of classification.

METHODOLOGY:

• Data Sources and Search terms

We conducted this review using a comprehensive search of MEDLINE, PubMed, and EMBASE, January 1985, through February 2017. The following search terms were used: osteomyelitis, causes of osteomyelitis, diagnosis of osteomyelitis, treatment of osteomyelitis

• Data Extraction

Two reviewers have independently reviewed the studies, abstracted data, and disagreements were resolved by consensus. Studies were evaluated for quality and a review protocol was followed throughout.

The study was approved by the ethical board of King Abdulaziz University Hospital

Causes

In hematogenous osteomyelitis a single pathogenic microbe is almost always recovered. In adults, the most common bacteria isolated was Staphylococcus aureus. Nevertheless, other gram-negative bacilli, gram-positive cocci (including coagulase-negative staphylococci and *Streptococcus* spp.) and anaerobic organisms (listed in descending order of incidence), are also commonly isolated, and in contiguous focus multiple bacteria are commonly isolated. In fact, other microbial species that were viable but unculturable can as well be present with the advent of molecular biology in diagnosis. However, determination is a must of these species that yield pathogenic importance. In infants, *Staphylococcus aureus*, *Streptococcus agalactiae*, and *Escherichia coli* are the pathogens most commonly isolated from blood or bone. However, *Staphylococcus aureus*, *Streptococcus pyogenes*, and *Haemophilus influenzae* are most frequently isolated, in kids whose age are over 1 year. dramatical decrease in incidence of *Haemophilus influenzae* infection after the age of 4, additionally, *Haemophilus influenzae* as a cause of osteomyelitis overall incidence is dramatically decreasing with the increase use of an improved *Haemophilus influenzae* vaccine [3; 4].

DIAGNOSIS:

Clinical manifestation

Depending on the category of organism, infection, anatomic location, and host, Manifestations may vary. Prepubertal kids often get infected with a hematogenous osteomyelitis which usually involve the metaphysis of long bones, tibia and femur in particular. Usual manifestations in patients presented with acute infection are fever, chills, pain, and local sings of inflammation. Most common site in adult is the vertebral bodies, followed by long bones, pelvis and clavicle.

The segmental arteries which divide to perfuse and nourish segments of two adjacent vertebrae are the primary blood supply of the vertebrae. Therefore, two contiguous vertebral bodies and the intervertebral disc are common sites of vertebral osteomyelitis [4].

Patients often present with fever, pain, and purulent drainage from traumatic or surgical wound in osteomyelitis that is caused by a contiguous focus of infection without vascular insufficiency. A later presentation can ensue in infections that involves prosthetic material, and with more subtle findings [4].

Infection usually occur in the small bones of the feet, in individuals who develop osteomyelitis in the setting of vascular insufficiency. Minimal pain due to neuropathy maybe experienced in these patients. Evidence of neuropathy and compromised vascular supply (e.g. diminished pulses, poor capillary refill) frequently revealed in physical exam. Site of infection can be contiguous of infection with a typical neuropathic ulcer, though it can be a cellulitis, paronychia, or puncture wound [5].

BLOOD TEST:

Osteomyelitis diagnosis can be hard to reach. osteomyelitis is present when bone is visible and if an ulcer is present during examination, or when the ulcer is probed with sterile instrument and bone is encountered. Nevertheless, osteomyelitis is not ruled out even when unable to probe to bone [6].

Lab tests that are routinely used are not usually specific. In the acute setting of osteomyelitis WBC count is often normal. ESR and CRP are usually increased; however, specificity of both are deficient in the absence of radiologic and data from microbiology. Assessment response to treatment or relapse of both tests can be used, in cases of proven osteomyelitis. In assessing response to therapy in children CRP can be more reliable [7].

MICROBIOLOGY:

When osteomyelitis is suspected blood cultures should always be obtained, except in cases of hematogenous osteomyelitis cases are often negative. Bone biopsy with histopathologic examination and tissue culture is the gold standard for diagnosis. Until bone biopsy is performed one should consider delaying empiric antibacterial therapy once patient is clinically stable. To ensure that adequate specimen is obtain an open approach is ideal, particularly with the involvement of prosthetic material. The sensitivity and specificity using needle biopsy which is often used have been reported as 87% and 93 % respectively. Aerobic and anaerobic bacterial culture should be used for every specimen. Additionally, during suspicion of organisms such as fungi and mycobacterium, cultures should be performed for each, respectively [8].

Draining wounds or ulcers are the often presentation of patients with suspected osteomyelitis. Culture should not be performed if no purulent material is present. Though it is never definitive, and interpretation must be with caution, culture of purulent material from such sites can be obtained if bone biopsy cannot be obtained. During surface cultures, primary pathogen can be missed due to the growth of skin flora, or secondary pathogen in the case of polymicrobial infection. It is not diagnostic during heavy growth of a common pathogen, rather suggestive. In deep culture, the presence of S. aureus in surface cultures has been correlated [8].

RADIOLOGY:

A bone scan, which is also known as scintigraphy, is handful in the work-up of osteomyelitis. Often technecium-99, a type of radiopharmaceutical, gather around in areas of increased blood flow and reactive bone formation. During setting that do not involve bone infection and only soft tissue infection, the three-phase bone scan should only show uptake on the first two phases, with normal uptake on the late (3-hour) images; uptake is seen in all three phases, in cases of osteomyelitis. In the setting of recent surgery or trauma, orthopedic devices, or diabetes, specificity decreases. An alternative to bone scan is radiolabeled white blood cell scan, with comparable sensitivity and specificity, despite that, it requires further technical preparation and time to perform [9].

Two great values in diagnosing and evaluating osteomyelitis are Computed tomography (CT) and magnetic resonance imaging (MRI). cortical destruction and soft tissue extension can be seen in both modalities. Artifact caused by adjacent metallic implants is a complication of CT. In the presence of some metal implants, though some prosthetic implants are MRI-compatible, MRI cannot be performed in such settings [10].

MANAGEMENT:

Adequate drainage, thorough debridement, obliteration of dead space, wound protection, and culture-directed antibiotic coverage, are all primary therapy for long bone osteomyelitis. Dealing with specific abnormalities such as diabetes, smoking cessation, are risk factors that should be paid a specific attention to, in addition, correction or improvement in host defense when patient is a compromised host.

Antibiotic therapy

Parenteral course of antibiotics should begin to cover clinically suspected microbes, once and directly after cultures have been obtained. Through sensitivity testing, a specific antibiotic or antibiotics are selected, once pathogen is recognized. Initiation of empiric broad-spectrum antibiotics can ensue when immediate debridement surgery is required before culture can be obtained, in addition, regimen modification is included when results of cultures and sensitivity tests are known. Either nafcillin or clindamycin (or vancomycin when MRSA, methicillin-resistant *Staphylococcus epidermidis*, or *Enterococcus* spp. are suspected) and ciprofloxacin (except with children, where an aminoglycoside should be used) is included as the initial antibiotic therapy for long bone osteomyelitis. The use of levofloxacin took part in the regimen; however, serum levels decline below minimum inhibitory concentrations, and at the current dosing failed in both human and animal osteomyelitis

cases. Post debridement surgery, bone requires 3 to 4 weeks to revascularize, and therefore antibiotics are initiated in the treatment of live infected bone and to set up a bone barrier as it undergoes revascularization. Patients are treated with 4 to 6 weeks of antimicrobial therapy, in addition to outpatient intravenous therapy which can be used, after the final major debridement surgery [11; 12].

Therapy with antibiotics can be directed with regard to the stage of infection. Due to children's highly vascular bones and the response effectiveness to infection, they can be treated with antibiotic therapy alone with Cierny-Mader stage 1 osteomyelitis. However, in adults, a stage 1 infection is more refractory to treatment and commonly is treated with surgery and antibiotics together. In stage 2 infections, after superficial debridement and soft tissue coverage, patients may be treated with a 2-week course of antibiotics. In these cases, around 80% is the arrest rate. individuals are treated with 4 to 6 weeks of antimicrobial therapy dated from the last major debridement in stages 3 and 4. Regardless of treatment duration, without adequate debridement most antibiotic regimens will fail at this stage of disease. Regardless of necrotic tissue being debrided, the remaining bed of tissue must be considered contaminated [3].

Surgical therapy

Often surgical therapy of osteomyelitis can be challenging. Bacterial load can be decreased with proper surgical debridement which also helps removing dead necrotic tissues and giving a chance for the host immune system and antibiotics to arrest infection. excessive debridement can leave huge bony defect, or dead space. To arrest the disease and maintain bone's integrity appropriate management of dead space is essential. The goal of dead-space management is the replacement with durable vascularized tissue from a dead bone and scar tissue. Usage of local flaps or free flaps to fill dead space in addition to complete wound closure which should be attained whenever possible. Until structural integrity has improved an alternative technique such as placing cancellous bone grafts beneath local or transferred tissues can be used [13]. Beads are commonly removed after 2 to 4 weeks and replacement with cancellous graft is made. vancomycin, tobramycin, and gentamicin are most often used as the antibiotics in the beads. Traditional treatment with two-stage procedure that involves initial debridement and antibiotic delivery, with initial external fixation, and then definitive internal fixation, is the method used in chronic osteomyelitis of bone with nonunion or bone defects. Conversion from two-stage processes into single-stage procedure can be achieved by using antibiotic cement-coated interlocking intramedullary nails which can also be used in patients who are not ideal candidates for external fixation, as well as in individuals who do not want to have external fixator applied [14].

Recent advances

Within the host osteoblast in patients with chronic osteomyelitis, intracellular persistent pathogen (*Staphylococcus aureus*) have been identified. The main cause of chronic osteomyelitis is biofilm formation on devitalized tissue, despite that, intracellular pathogens may as well have a role at some point in the pathogenesis of this disease. This discovery can lead to the development of new modalities in the therapy of chronic osteomyelitis [15].

CONCLUSION:

Treatment of long bone osteomyelitis is hard and is a significant cause of morbidity and expense. The aim of treatment is to stop the spread of osteomyelitis and repair the damage it has caused. proper therapy consists of culture-directed antibiotic therapy and surgical debridement of all bone with necrosis and soft tissue. Antibiotic therapy (including a combination of antibiotics and a variety of delivery systems), debridement (often multiple), dead space management, soft tissue coverage, restoration of blood supply, and stabilization, are the stages of treatment. It is essential that affected individuals understand the importance of proper nutrition and the negative effects of smoking and other bad habits. overall, clear understanding of the goals of treatment and the difficulties that may persist after the beginning of therapy course and surgical intervention must be shared between caregiver and patients.

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